

SUPPORT FOR THE AMENDMENT

Support for the amendments to claim 1 is found in claims 3 and 9 as originally presented on page 12, lines 3-17 of the specification. No new matter would be added to this application by entry of this amendment. No new issues would be raised by entry of applicants' amendment as applicants have merely introduced the limitations of existing dependent claims as well as addressed the examiner's concern, raised on page 4 of the official action, of the use of a tetraalkoxysilane in the examples in the specification. Entry of applicants' amendment and full consideration thereof at this stage of prosecution is respectfully requested.

Upon entry of this amendment, claims 1, 2, 4-8 and 10-16 will now be active in this application.

### REQUEST FOR RECONSIDERATION

The claimed invention is directed to a hologram recording material and a process for producing same.

Applicants wish to thank examiner Angebrannndt for the helpful and courteous discussion held with their U.S. representative on February 19, 2009. At that time the examiner noted that the specification examples were more limited than the claimed subject matter in terms of incorporation of a tetraalkoxysilane. The following is intended to expand upon the discussion with the examiner.

Hologram recording materials are typically valued based on properties of a high refractive index change at the time of recording, a high sensitivity, low scattering, environmental resistance, durability, low dimensional changes and high multiplicity. Issues as to environmental resistance and durability has focused on inorganic matrix materials as well as hybrid materials. Issues with inorganic hybrid matrix materials have focused on the uniformity of film formation, compatibility with the optically active monomer, curing speed and refractive index. Research continues into hologram recording materials having good properties.

The claimed invention addresses this problem by providing a hologram recording material comprising a metal oxide matrix and a photopolymerizable compound, wherein the metal oxide matrix has a halogen-containing organic group and an organic group containing no halogen. Applicants have discovered that the presence of a halogen-containing organic group in the metal oxide matrix which also contains an organic group containing no halogen provides a material having a high refractive index, high sensitivity, low scattering, environmental resistance, durability, low dimensional change, high multiplicity and compatibility with a polymerizable monomer. Such a hologram recording material is nowhere disclosed or suggested in the cited references of record.

The rejection of claims 1-10, 12-14 and 16 under 35 U.S.C. §103(a) over Chandross et al. EP 938,027 in view of Loy et al. *Chem Mater*, Shustack et al. U.S. '566 and Hiruma et al. U.S. '831 is respectfully traversed.

None of the cited references of record disclose or suggest the claimed hologram recording material having a halogen-containing organic group nor the improved compatibility between the matrix and the photopolymerizable monomer resulting there from.

Chandross et al. EP '027 has been cited for a disclosure of a holographic recording medium based on methyltriethoxysilane, phenyltriethoxysilane, lauryl acrylate and a photoinitiator which is hydrolyzed to form a holographic recording material (examples 1-3). EP '027 corresponds with the disclosure in JP A-11-344917 discussed on page 3, lines 1-18 of applicants' specification and is reproduced below:

[0005] JP-A-11-344917 discloses an optical recording medium wherein an organic-inorganic hybrid matrix contains an optically active monomer. In the organic-inorganic hybrid matrix, a metal element has an alkyl group (a methyl group) or an aryl group (a phenyl group). However, the introduction of the methyl group makes it impossible to improve the compatibility between the hybrid matrix and the optically active monomer. The introduction of the phenyl group gives a more improvement in the compatibility than the introduction of the methyl group. However, the introduction of the phenyl group causes a fall in the curing speed

of a hybrid matrix precursor ([0015] in the above publication), and causes a rise in the refractive index of the hybrid matrix. If the refractive index of the hybrid matrix becomes high to approach the refractive index of the optically active monomer or a polymer therefrom, a high refractive index change is not easily obtained at the time of recording. This fact makes the flexibility in recording medium design narrow.

Above [0015] corresponds to [0016] of EP 938 027.

While the reference discloses an alkyl (a methyl group) or aryl group (a phenyl group) and that **the organic components** provide compatibility with the organic components (the photoactive monomer) of the photoimageable system, there is no disclosure of a halogen-containing organic group.

Loy et al. has been cited for a disclosure of sol-gels with halogen containing organic groups and that chloromethyl and chloromethylphenyl groups **react more slowly** than methyl, the **pore diameter** of chloromethyl is slightly **larger** than for that of methyl and that hydrogen, methyl and chloromethyl are **more transparent** than ethyl, dodecyl, hexadecyl, octadecyl and vinyl (page 3629, Table 6). While the official action asserts that it would have been obvious to one of ordinary skill in the art, based on the disclosed transparency in Loy et al. to have replaced the methytriethoxysilane of EP '027 with a chloromethyltriethoxysilane as disclosed in Loy et al., the measured transparency is for **that of the gel** its self, and not for a photorecording medium containing a photoactive organic monomer. There is no suggestion that a halogen-containing group would be more transparent than non-halogenated group or any suggestion of an enhanced compatibility between the gel and the photopolymerizable monomer or a polymer generated by polymerization of the monomer. Accordingly, the mere disclosure of transparency of the gel it self fails to provide motivation to replace methyltriethoxysilane with chloromethyltriethoxysilane nor provide any expectation of enhanced compatibility between the matrix and a photopolymerizable monomer or a polymer generated by the photopolymerizable monomer.

Enhanced compatibility is not suggested by either of the references of Shustack et al. or Hiruma et al.

Shustack et al. has been cited for a disclosure that (bromophenyl)trimethoxysilane and (chlorophenyl)trimethoxysilane **lowers scattering losses** in the field of fiber optic communications. The reference discloses at paragraph [0025] that a coupling agent having a

high refractive index provides a material with a smooth refractive index gradient between the condensed metal oxide nanoparticles and the somewhat lower refractive index organic portion of the materials, and therefore **lowers scattering loss**. The reference further identifies functionalities of chlorine, bromine, iodine, sulfur, selenium, phosphorus, an aromatic ring or a highly conjugated unsaturated system as providing a high refractive index (pg 3, left column, lines 15-21). Thus, the effect of halogen substitution is expected to lower scatter loss. There is no suggestion of improved compatibility with a photopolymerizable monomer.

Hiruma et al. describes inclusion of a silane coupling agent to a primer layer to improve the bonding power to the support and imparting water resistance to the primer layer. There is no disclosure of improving compatibility with a photopolymerizable monomer.

There simply is no suggestion in the cited secondary references of enhanced compatibility by introduction of a halogen into the matrix material.

*Applicants Have Demonstrated Improved Compatibility with A Photopolymerizable Organic Compound*

Moreover, applicants observe a high dynamic range based on diffraction efficiency for the claimed halogen-containing organic group over non-halogen containing organic groups. The examiner's attention is directed to the data appearing in the specification in example 1 and comparative examples 1 and 2.

Comparative example 1 was formed from tetraethoxysilane (TEOS) and methyltriethoxysilane and a photopolymerizable organic compound as described on pages 24-25 of the specification was added thereto. When applied to a glass substrate **the matrix material separated** from the organic compound and were **not hybridized**. Holographic recording was not permitted.

Comparative example 2 was formed from TEOS and phenyltriethoxysilane and the same photopolymerizable organic compound used in comparative example 1. The resulting

holographic recording material demonstrated a dynamic range **M# of only 0.7**, a white cloudiness and a transmittance at 532 nm **decreased by 5%**, relative to example 1.

In contrast, example 1, formed from TEOA and **chloropropyl**triethoxysilane and the same photopolymerizable organic compound used in comparative example 1 demonstrated a dynamic range: **M# of 1.6** and a transmittance at 532 nm which **did not decrease** before and after recording. Thus, by inclusion of a halogen-containing organic group in the metal oxide matrix, applicants observe improvements in a holographic recording material which are not suggested by the cited references. Applicants further note that the claims have been amended to recite the presence of an organic group which does not contain a halogen group, consistent with the data provided by applicants.

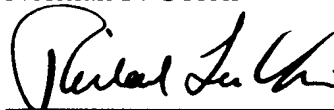
As the cited combination of references neither discloses or suggest the claimed combination nor the improvements in a holographic recording material resulting there from, the claimed invention is not rendered obvious from the cited references and withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

Applicants submit that this application is now in condition for allowance and early notification of such action is earnestly solicited.

Respectfully submitted,

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